IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:	)	
	)	
Carlson et al.	)	
	)	
Serial No.: 10/596,321	)	Group Art Unit: 2624
	)	
Filed: June 9, 2006	)	Examiner: David Peter Zarka
	)	
For: ELASTIC IMAGE REGISTRATION	)	**Board of Patent Appeals and**
	)	**Interferences**
Confirmation No.: 5336	)	

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APPEAL BRIEF UNDER 37 C.F.R. § 41.37

   In response to the Notice of Appeal filed on August 22, 2011, and pursuant to 37
C.F.R. § 41.37, Appellants present this appeal brief in the above-captioned application.

   This is an appeal to the Board of Patent Appeals and Interferences from the
Examiner's final rejection of claims 1-10 in the Final Office Action dated April 20, 2011. The
appealed claims are set forth in the attached Claims Appendix.

1.   Real Party in Interest

         This application is assigned to Koninklijke Philips Electronic, N.V., the real party
in interest.

2.   Related Appeals and Interferences

         There are no other appeals or interferences that would directly affect, be directly
affected, or have a bearing on the instant appeal.

3.   Status of the Claims

         Claims 1-10 have been rejected in the Final Office Action. The final rejection of
claims 1-10 is being appealed.

4.   Status of Amendments

         All amendments submitted by Appellants have been entered.

5.   Summary of Claimed Subject Matter

         The present invention, as recited in independent claim 1, relates to the field of
digital imaging. (*See* Specification p. 1, ll. 5-6, fig. 1). In particular, the present invention
describes a method of registering a first image and a second image. (*See* Specification p. 1, ll.
6-7, fig. 2). The method comprises several steps. The first step is to select, by an image
processing device, at least one first landmark in the first image. (*See* Specification p. 7, ll. 4-7
and 24-29, figs. 2 and 3).   The next step is to select, by an image processing device, at least one
second landmark in the second image. (*See* Specification p. 7, ll. 4-11 and 24-29, figs. 2 and 3).
The at least one first landmark corresponds to the at least one second landmark. (*See*
Specification p. 7, ll. 24-29, figs. 2 and 3). The next step is to register, by an image processing
device, the first and second images by using a similarity value which relates to a similarity of a
first region in the first image determined by the at least one first landmark and a second region in
the second image determined by the at least one second landmark. (*See* Specification p. 8, l. 32
to p. 9, l. 5, fig. 2). The registering includes selecting at least one further first landmark in the

first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value. (*See* Specification p. 9, ll. 7-26, figs. 3-6).

      The present invention, as recited in independent claim 2, is directed to a method for registering a first image and a second image. The method comprises several steps. The first step is to select, by an image processing device, at least one first landmark in the first image. (*See* Specification p. 7, ll. 4-7 and 24-29, figs. 2 and 3). The next step is to select, by an image processing device, at least one second landmark in the second image. (*See* Specification p. 7, ll. 4-11 and 24-29, figs. 2 and 3). The at least one first landmark corresponds to the at least one second landmark. (*See* Specification p. 7, ll. 24-29, figs. 2 and 3). The next step is to register, by an image processing device, the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark. (*See* Specification p. 8, l. 32 to p. 9, l. 5, fig. 2). The registering includes selecting at least one further first landmark in the first image and at least one further second landmark in the second image as a function of a pre-selected value of the similarity value. (*See* Specification p. 9, ll. 7-26, figs. 3-6). For the first image having a first number of dimensions, a second number of first landmarks is selected. (*See* Specification p. 9, ll. 14-26, figs. 3-6). For the second image having the first number of dimensions, a third number of second landmarks is selected. (*See* Id.). The second number of first landmarks determines first vertices of first simplices for determining a fourth number of regions in the first image. (*See* Id.). The third number of second landmarks determine second vertices of second simplices for determining the fourth number of regions in the second image. (*See* Id.). The second number is the first number plus one. (*See* Id.). The first and second landmarks are selected in accordance with a qualifying function. (*See* Id.). The third number is equal to the second number. (*See* Id.).

      The present invention, as recited in independent claim 8, is directed to an image processing device. (*See* Specification p. 1, ll. 5-9, p. 6, ll. 8-19, fig. 1). In particular, the present invention describes an image processing device, comprising a memory for storing a first image and a second image (*See* Specification p. 6, ll. 11-13, fig. 1, item 2), and an image processor for registering the first image and the second image. (*See* Specification p. 6, ll. 10-19, fig. 2, item 1).

The image processor is adapted to perform the following operation (*See* Specification p. 6, ll. 8-10): selecting at least one first landmark in the first image (*See* Specification p. 7, ll. 4-7 and 24-29, figs. 2 and 3); selecting at least one second landmark in the second image (*See* Specification p. 7, ll. 4-11 and 24-29, figs. 2 and 3); and registering the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark (*See* Specification p. 8, l. 32 to p. 9, l. 5, fig. 2); wherein the at least one first landmark corresponds to the at least one second landmark (*See* Specification p. 7, ll. 24-29, figs. 2 and 3), and wherein the registering includes selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value (*See* Specification p. 9, ll. 7-26, figs. 3-6).

The present invention, as recited in dependent claim 9, is directed to a computer program on a computer-readable device. (*See* Specification p. 1, ll. 5-9, p. 6, ll. 8-19, fig. 1). In particular, the present invention describes a computer program on a computer-readable device for registering a first image and a second image, wherein the computer program causes a processor to perform the following operation when the computer program is executed on the processor (*See* Specification p. 1, ll. 5-9, p. 6, ll. 8-19, fig. 1): selecting at least one first landmark in the first image (*See* Specification p. 7, ll. 4-7 and 24-29, figs. 2 and 3); selecting at least one second landmark in the second image (*See* Specification p. 7, ll. 4-11 and 24-29, figs. 2 and 3); and registering the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark (*See* Specification p. 8, l. 32 to p. 9, l. 5, fig. 2); wherein the at least one first landmark corresponds to the at least one second landmark (*See* Specification p. 7, ll. 24-29, figs. 2 and 3), and wherein the registering includes selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value (*See* Specification p. 9, ll. 7-26, figs. 3-6).

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6.   Grounds of Rejection to be Reviewed on Appeal

    I.   Whether claims 1-10 are unpatentable under 35 U.S.C. § 112, first paragraph, for failing to comply with the written description requirement.

    II.   Whether claims 1 and 8-10 are unpatentable under 35 U.S.C. § 102(b) as anticipated by U.S. Patent Publication No. 2003/0048955 to Pardas et al. (hereinafter "Pardas").

7.   Argument

    I.   The Rejection of Claims 1-10 Under 35 U.S.C. § 112, first paragraph, Should Be Reversed.

        A.   The Examiner's Rejection

In the Final Office Action, the Examiner rejected claims 1-10 Under 35 U.S.C. § 112, first paragraph, for failing to comply with the written description requirement. (*See* 4/20/11 Office Action, p. 3).

        B.   The Specification Provides Support For The Claim Recitations

The Examiner asserts that the specification only provides support only for selecting at least one further landmark in the second image, but not the first. (*Id.* at p. 3). Appellants respectfully disagree and direct the Examiner's attention to page 7, lines 24-27 of the originally filed application. This portion of the specification explains that after the images to be registered are acquired, a plurality "of significant landmarks $\{L_i\}$ is selected in **both** images A and B, which can be unambiguously assigned or allotted to each other, i.e. which unambiguously correspond to each other." So, it is clear that when a landmark is selected in one image, a corresponding landmark is selected in the other image. A similarity value S signifies the similarity of a simplex $\{Pi\}$ in the floating image A to the reference image B. (*See* Specification, p. 9, ll. 7-12). Thus, when a landmark is selected in one image (A), a corresponding landmark is selected in the other image (B) so that a similarity (S) of the new simplex in both images can be determined.

Originally filed Figures 3-6 show the claimed method that is performed to both the first and the second image. However, these figures show the progression of the claimed method on **one and the same** image (either the first image or the second image). However, the steps shown in Figures 3-6 are performed on both images (A and B). So, in Fig. 5, when an additional landmark L_6 is selected, that landmark is selected in both the first and the second images. The same concept applies to the addition landmark L_7. If a point is selected in the first image, a corresponding point must also be selected in the second image. One of ordinary skill in the art would understand that this process is necessary in order to determine a similarity between the first and the second images.

The Examiner asserted the Appellants' reference to the above-cited portions of the Specification do not relate to Figures 3-6 of the present Application. (*See* 7/27/11 Advisory Action, p. 2). The Examiner also asserts that the Specification "explicitly supports that figs. 3-6 are also separate images and not the same image." (*See* 7/27/11 Advisory Action, p. 3) (referring to Specification, p. 5, ll. 30-31). Initially, Appellants note that the Examiner is basing this flawed interpretation on the short description of the figures although the detailed portion of the Specification proves that this interpretation is incorrect. Appellants direct the Examiner's attention to page 7, line 28 – page 8 line 1, which states

> "For a two-dimensional image, the simplices are triangles, and for a three-dimensional image, the simplices are tetrahedrons. This is shown in further detail in Fig. 3, depicting image *A* **or** image *B*, where five landmarks L_1 to L_5 have been selected."

(emphasis added). Figure 4 is a detailed image of the "affine transformation" performed on the image (A **or** B) in Fig. 3. (*See* Specification, p. 8, ll. 15-19). Figure 5 shows the subsequent step of selecting a new landmark. (*See* Specification, p. 9, ll. 14-17). The phrase "new landmark" indicates that there must have been "old landmarks" present. So, one of ordinary skill in the art would understand that Fig. 5 shows the same image (A **or** B) as Fig. 4, but with the "new landmark." Figure 6 shows an additional landmark added to the image shown in Fig. 5. (*See* Specification, p. 9, l. 27 – p. 10, l. 11).

It appears based on the Final Office Action and the interview that the Examiner had interpreted the images in Figs. 3-6 to each be a separate image. (*See* 4/20/11 Office Action, p. 3). However, as explained above and during the telephone interview conducted on July 20, 2011, Figs. 3-6 represent the same image. Moreover, there is no physical change to the image in any of Figs. 3-6. The selection of the landmarks does not represent a physical change to the image, but rather a further processing of data that is always contained in the image. Thus, the landmarks and corresponding triangle edges shown in, for example, Fig. 5, are not actually shown in the image, but rather are an illustration of the processing that may be performed on the image data based on the exemplary embodiments. Thus, Figs. 3-6 represent only a single image.

Page 8, line 31 – page 10, line 10 of the originally filed specification explains the process and the reason for selecting a new landmark in both images. If, with the current landmarks (e.g. Fig. 4) a similarity measurement between the two images (A and B) is below a threshold, another landmark is chosen **in both image** (A and B) so that a new similarity measurement can be determined for a simplex (P) so that the new similarity measurement is at or above the predetermined threshold value. Without selecting a landmark in the first image and a corresponding landmark in the second image, the similarity cannot be determined for the new simplex created (e.g. in Fig. 5). Accordingly, Appellants respectfully request the withdrawal of the 35 U.S.C. § 112 rejection.

II.   The Rejection of Claims 1 and 8-10 under U.S.C. § 102(b) as Anticipated by Pardas Should Be Reversed.

   A.   The Examiner's Rejection

In the Final Office Action, the Examiner rejected claims 1 and 8-10 under 35 U.S.C. § 102(b) as anticipated by Pardas. (See 4/20/11 Office Action, pp. 4-6).

   B.   The Cited Patent Does Not Disclose The Registering Includes Selecting At Least One Further First Landmark In The First Image And At Least One Further Second Landmark In The Second Image If The Similarity Value Is Less Than A Pre-selected Value, As Recited In Claim 1.

Prior to discussing Pardas, the Appellants refer the Examiner to the above description for the proper interpretation of the highlighted portion of the claim language. Again, the *"selecting at least one further first landmark in the first image"* is shown, for example, in Fig. 5, when landmark L6 is selected. However, as described above, the exact same *"selecting . . . at least one further second landmark in the second image"* is performed. This may also be illustrated by Fig. 5. That is, the same operation is performed to the two images, but Fig. 5 is only illustrating the operation on one of the images (either the first image or the second image).

Pardas discloses a method for coding a sequence of pictures using an active triangular mesh coding scheme and a partition tree. (*See* Pardas, Abstract). The method of Pardas begins with a block mesh whose mesh elements are subsequently divided into two triangles. (*Id.* at ¶ [0050]). Pardas discloses that new triangles must either be introduced (segmentation 141) or removed (merging 142) because of modifications of the scene content. (*Id.* at ¶ [0056]). There are two criteria used to determine which triangles should be segmented in the segmentation step (141). The first is that one new edge of the triangle should follow the high gradient if a high gradient component of the signal crosses one of the triangle's edges. The second criterion is that a large triangle should be segmented into smaller triangles since the large triangle would most likely produce synthesis errors. (*Id.* at ¶ [0057]). The merging step (142) removes triangles that are either small or degenerated. (*Id.* at ¶ [0058]).

The Examiner refers to a reproduced version of Figure 20 of Pardas and states that "each set of mesh proposals in fig. 20 divides the underlying image into a plurality of images" and "each mesh…is its own image" to meet the recitations of claim 1. (*See* 4/20/11 Office Action, pp. 4-7). Appellants respectfully disagree with the Examiner's interpretation of Pardas and of Figure 20. Figure 20 merely displays the set of mesh proposals from the original projected mesh. (*See* Pardas, ¶ [0067], Fig. 20). There are five levels in Figure 20. The original projected mesh is the displayed at the middle level. Segmentation is displayed descending from the middle level. Merging is displayed ascending from the middle level. (*Id.* at ¶ [0067]). So, the two levels above the original projected mesh in the middle level are subsequent levels of the merging step. In the level directly above the original projected mesh, the two mesh elements at the right have been merged, resulting in one big element on the right and two smaller ones on the

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left. (*Id.*). The uppermost level is the result of a further merging step, which merges the remaining two elements that were on the left in the preceding level. Thus, the different levels in this figure are NOT different images. They are the same image, but after merging or segmentation. Performing merging or segmentation on an image does not make it a different image.

The Examiner tries to cure this deficiency by asserting that "the fact the 'hierarchical set of meshes…in fig. 20 are separate and each contain their own distinct set of pixels (where the same or not is irrelevant) creates separate images." (*See* 7/27/11 Advisory Action, p. 4) (referring to Pardas, ¶ [0067]). Appellants strongly disagree with the Examiner's interpretation and respectfully submit that one of ordinary skill in the art would understand that creating a set of meshes, although different, of an image does not modify the image at all. A mesh with 2 elements compared to a mesh with 2,000 elements is not a different image. The fact that the underlying image is the same is completely relevant. Accordingly, Pardas fails to disclose or suggest "registering, by an image processing device, the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark," as recited in claim 1.

Furthermore, the Examiner states that determining whether a high gradient component of the signal crosses on edge of this triangle is a value (yes or no) and that the determination of whether the triangle is of a very large size is also a value (yes or no). (*See* 4/20/11 Office Action, p. 5). In view of the above description of the claimed invention, these determinations are markedly different than the recitation in claim 1 of "a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark." That is, the determinations of Pardas are not with regards to two different images. It seems the Examiner tries to cure this deficiency by stating that the segmentation of a large triangle into two triangles creates a new image. (See *Id.*). Appellants respectfully disagree. One of ordinary skill in the art would not determine the similarity between the original triangle and the segmented triangle because it is clear that the segmented triangle is merely a modification of the original, larger triangle. Thus,

Pardas does not disclose or suggest "registering, by an image processing device, the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark, *the registering including selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value*." Accordingly, Appellants respectfully request the withdrawal of the 35 U.S.C. § 102(b) of claim 1 and its dependent claim 10.

Independent claims 8 and 9 recite a similar limitation as described above for claim 1. Accordingly, the 35 U.S.C. §102(b) rejection of these claims should be withdrawn.

Conclusion

For the reasons set forth above, Appellants respectfully request that the Board reverse the 35 U.S.C. §§ 112 and 102(b) rejections of the claims by the Examiner and indicate that claims 1-10 are allowable.

Respectfully submitted,

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CLAIMS APPENDIX

1. (Previously Presented) A method of registering a first image and a second image, the method comprising the steps of:

selecting, by an image processing device, at least one first landmark in the first image;

selecting, by an image processing device, at least one second landmark in the second image, wherein the at least one first landmark corresponds to the at least one second landmark; and

registering, by an image processing device, the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark, the registering including selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value.

2. (Previously Presented) A method of registering a first image and a second image, the method comprising the steps of:

selecting, by an image processing device, at least one first landmark in the first image;

selecting, by an image processing device, at least one second landmark in the second image, wherein the at least one first landmark corresponds to the at least one second landmark; and

registering, by an image processing device, the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark, the registering including selecting at least one further first landmark in the first image and at least one further second landmark in the second image as a function of a pre-selected value of the similarity value,

wherein, for the first image having a first number of dimensions, a second number of first landmarks is selected; wherein, for the second image having the first number of dimensions, a third number of second landmarks is selected; wherein the second number of first landmarks determine first vertices of first simplices for determining a fourth number of regions in the first

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image; wherein the third number of second landmarks determine second vertices of second simplices for determining the fourth number of regions in the second image; wherein the second number is the first number plus one; wherein the first and second landmarks are selected in accordance with a qualifying function; and wherein the third number is equal to the second number.

3. (Previously Presented) The method of claim 2, wherein, for each of the second number of second landmarks, the local deformation field is determined for determining a first global deformation field which approximately describes a deformation required to the first image for registration onto the second image.

4. (Previously Presented) The method of claim 3, wherein, for each of the fourth number of regions in the first image, a first similarity value is determined relating to a similarity between a respective one of the regions in the first image to a respective corresponding one of the regions in the second image by using the first global deformation field.

5. (Previously Presented) The method of claim 4, wherein it is determined whether there is a fifth region of the regions in the first image in which the first similarity value is less than a preset threshold value; wherein, when there is a fifth region, a third landmark is selected in the fifth region for determining third simplices in the fifth region which determine a plurality of sixth regions; wherein, when there is a fifth region, a fourth landmark is selected in a seventh region of the regions in the second image for determining fourth simplices in the seventh region which determine a plurality of eighth regions; wherein the third landmark corresponds to the fourth landmark such that the sixth regions correspond to the eighth regions; wherein, for each of the sixth regions, a second similarity value is determined relating to a similarity between a respective one of the sixth regions to a respective one of the eighth regions by using a second global deformation field which has been refined by using a further local deformation field of the third landmark.

6. (Original) The method of claim 5, wherein the method is iteratively repeated until all similarities exceed the preset threshold value.

7. (Original) The method of claim 1, wherein the method is applied in medical imaging to one of CT data sets, MRI data sets, PET data sets, SPECT data sets, and ultrasonic imaging data sets.

8. (Previously Presented) Image processing device, comprising:

a memory for storing a first image and a second image; and

an image processor for registering the first image and the second image,

wherein the image processor is adapted to perform the following operation:

selecting at least one first landmark in the first image;

selecting at least one second landmark in the second image, wherein the at least one first landmark corresponds to the at least one second landmark; and

registering the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark, the registering including selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value.

9. (Previously Presented) Computer program on a computer-readable device for registering a first image and a second image, wherein the computer program causes a processor to perform the following operation when the computer program is executed on the processor:

selecting at least one first landmark in the first image;

selecting at least one second landmark in the second image, wherein the at least one first landmark corresponds to the at least one second landmark; and

registering the first and second images by using a similarity value which relates to a similarity of a first region in the first image determined by the at least one first landmark and a second region in the second image determined by the at least one second landmark, the registering including selecting at least one further first landmark in the first image and at least one further second landmark in the second image if the similarity value is less than a pre-selected value.

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10. (Previously Presented) The method of claim 1, wherein the selecting the at least one further first landmark in the first image and the at least one further second landmark in the second image is based on the similarity value not exceeding the pre-selected value.

EVIDENCE APPENDIX

No evidence has been entered or relied upon in the present appeal.

RELATED PROCEEDING APPENDIX

No decisions have been rendered regarding the present appeal or any proceedings related thereto.